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ABSTRACT

This review and synthesis of research focuses on studies of cost-effectiveness of vocational education. This paper represents an overview of the state of the art and includes (1) a review of the current conceptual and empirical problems of conducting a cost-efficiency or cost-effectiveness study of vocational education; (2) a review of the major findings of past studies of vocational education with special emphasis on the studies since 1970; (3) suggestions for future research on cost-efficiency and cost-effectiveness of vocational education. The author deals only with traditional, in-school secondary vocational programs and postsecondary vocational education programs, not cooperative educational and manpower training programs. (BM)

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STUDIES OF THE COST-EFFICIENCY AND COST-EFFECTIVENESS OF VOCATIONAL EDUCATION

written by

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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FOREWORD

The social and economic benefits derived from vocational education have been the subject of some debate. Educational policy makers, legislators, the general public, and vocational educators alike have been involved in questions concerning the magnitude of the costs of vocational education, the efficiency of vocational education as a training delivery system, and the effectiveness and benefits of vocational education.

A number of research studies have examined these questions and have determined for specific locales and time periods the costs of and returns to vocational training. Although the lack of strong research methodology and rigorous statistical analysis has plagued past cost-benefit studies, well conducted research can yield important information for the planning and design of vocational programs. Cost-efficiency and cost-effectiveness studies of vocational education can provide important data for accountability, for determining the optimal scale or least cost condition of a program, for reallocation of resources, and for evaluation. This paper examines the concepts of cost-efficiency and cost-effectiveness of vocational education, provides a conceptual framework for and discusses problems in conducting such studies, and reviews major findings of past research.

"Studies of the Cost-Efficiency and Cost-Effectiveness of Vocational Education" is one of six interpretive papers produced during the second year of the National Center's knowledge transformation program. The review and synthesis in each topic area is intended to communicate knowledge and suggest applications. Papers in the series should be of interest to all vocational educators, including teachers, administrators, federal agency personnel, researchers, and the National Center staff.

The profession is indebted to Dr. Teh-wei Hu for his scholarship in preparing this paper. Recognition is also due Dr. Gerald P. Glyde, The Pennsylvania State University; Dr. Maw Lin Lee, University of Missouri-Columbia; and Dr. Robert L. Darcy, the National Center for Research in Vocational Education, for their critical review of the manuscript. Dr. Carol P. Kowle supervised publication of the series. Mrs. Ann Kangas and Mrs. Margaret Starbuck assisted.

Robert E. Taylor
Executive Director
The National Center for Research in
Vocational Education

INTRODUCTION

Vocational education is a major component of our secondary and postsecondary education system. It is considered one of the important educational programs for students in the transition from school to work. It is also considered, however, as being more expensive than other secondary educational programs. The constant concern over and debate on the merits of vocational education by educators, educational policy makers, and the public have been drawing many researchers to examine the costs of vocational education, the efficiency of vocational education, and the effectiveness and benefits of vocational education.

Cost-efficiency and cost-effectiveness analyses can provide information on the following subjects to educators and policy makers (Davie, 1967; Stromsdorfer, 1972):

(a) Accountability. Cost analysis alone can be helpful in accounting for the use of public funds. Since governments are the primary sources of funds for vocational education, government officials and the public demand information on costs of vocational education.

(b) Efficiency. Cost analysis can shed light on the question of the optimal scale (size) or the least cost condition of a vocational education program. Obviously, information on the optimal scale of vocational education would be extremely useful to educational administrators and government officials.

(c) Resource reallocation. Cost-effectiveness and cost-benefit analyses can help to assess the alternative courses of action aiding decision makers in maximizing the well-being of society. In order to make meaningful comparisons, both effectiveness (or benefits) and costs should be measured.

(d) Evaluation. Cost-effectiveness and cost-benefit analyses can be used as evaluation tools to monitor the efficiency and effectiveness of the educational program; thus, educational administrators can modify or improve the process of vocational programs.

Cost-efficiency, cost-effectiveness, and cost-benefit analyses are economic techniques devised to evaluate programs by providing information on the optimal allocation of limited resources among competing needs. Although these three types of analysis have the same objective, they differ in scope and degree.

Any social or educational program can be divided into three components: inputs, process, and outcome. In a narrow sense,

cost-efficiency focuses on input (teaching staff, equipment) and process (student/teacher ratio, staffing pattern) evaluation. It examines the relationship between the costs of a program and the output (number of students in the program), such as the average cost per student and additional costs for additional students (marginal costs). In other words, cost-efficiency focuses on the least possible cost to train a vocational student. It is a cost analysis and a part of the cost-effectiveness or cost-benefit analysis. It is possible that a vocational program is not cost-effective, not because of the lack of effectiveness, but because it was administered inefficiently. If one can reduce the cost of the program, it may become cost-effective. A cost-efficiency analysis examines whether or not a program is operating under the least possible cost condition.

Cost-effectiveness and cost-benefit analyses are attempts to examine the relationship between the costs of a program and the outcomes of a program. Outcomes may be measured in monetary terms (earnings and wages) or nonmonetary terms (time unemployed, job satisfaction, etc.). Cost-effectiveness analysis provides the information about the effect of resources (in monetary or nonmonetary terms) in relation to the value of resources used for vocational education. Cost-effectiveness analysis also concerns how to achieve a given outcome using the least resources. Cost-benefits analysis, in a narrow sense, provides the information about the costs and returns of vocational education in the form of benefit-cost ratio, net benefit (total benefit minus total costs), or the rate of return. Since not all outcomes of vocational education can be expressed in monetary terms, it would be useful in this paper to adopt cost-effectiveness as a broader term which includes both the monetary and nonmonetary costs and benefits of vocational education (Woodhall, 1970; Zymelman, 1976).

Although cost-effectiveness and cost-benefit analyses provide useful information for policy makers, there are several weaknesses of a straightforward economic benefit-cost analysis. First, some cost and benefit indicators are only partial or proxy measures for total costs and benefits. Certain benefits and costs are difficult to quantify or to evaluate in monetary terms. Second, in estimating the benefits and costs of a program based on actual data, economists often make several strong assumptions in order to use these data for the purpose of evaluation (i.e., the choice of discount rate, the choice of time period, and the monetary imputation). Third, the benefit-cost ratio may be misleading if it is calculated for the program as a whole. Policy makers are interested in the effectiveness of resources at the margin. The benefit-cost ratio for the program as a whole may provide misleading information for incremental decisions (Davie, 1967; Hu and Stromsdorfer, 1979).

Therefore, one should not accept these cost-effectiveness and cost-benefit analyses without question. They are not final answers and they do not tell us everything. Only by recognizing the limitations of cost-efficiency and cost-effectiveness analyses can one avoid either extreme of total skepticism or complete acceptance. With these caveats in mind, one can still conclude that cost-effectiveness and cost-benefit analyses are useful tools for decision making. The most important contribution of cost-efficiency and cost-effectiveness analyses is not their numerical numbers, but the rationale they provide for decision making. These methodologies can provide a better approach to and understanding of program planning and resource allocation.

Numerous studies of the cost-efficiency and cost-effectiveness (benefits) analyses of vocational education have been published since the Vocational Education Act of 1963 (P.L. 88-210). One extensive review of these studies was completed in the late 1960s (Warmbrod, 1968) and another in the early 1970s (Stromsdorfer, 1972).

This paper represents an overview of the state of the art at the present time. Its purposes are to (1) review the current state of art of the conceptual and empirical problems of conducting a cost-efficiency or cost-effectiveness study of vocational education; (2) review the major findings of past studies of vocational education with special emphasis on the studies since 1970; and (3) provide suggestions for future research on cost-efficiency and cost-effectiveness of vocational education. The plan of this paper is as follows: the first two sections will include a discussion of the conceptual framework and problems involved in conducting cost-efficiency analysis, and will give the major findings of cost-efficiency analysis of vocational education. These will be followed by a discussion of the conceptual framework and problems involved in conducting cost-effectiveness analysis, with a summary of the major findings of cost-effectiveness studies of vocational education. Finally, future research and directions of cost-efficiency and cost-effectiveness analyses in vocational education will be discussed.

There are many forms of vocational education. This paper will focus on traditional in-school secondary level students and students in postsecondary vocational education. Cost-effectiveness and cost-benefit analyses of cooperative educational programs and manpower training programs are not included.

CONCEPTUAL FRAMEWORK AND PROBLEMS IN CONDUCTING COST-EFFICIENCY ANALYSIS

Vocational education costs are defined as the value of resources used for vocational education programs. These involve the costs of both providing and receiving the training. In general, costs can be classified as social, public, and private. Social costs are incurred by the entire society and include both public and private costs. Public costs include the costs expended by governmental units (federal, state, and local), while private costs include the costs incurred by individual program participants (incidental costs to participants and earnings foregone while participating in the program) and donations from private organizations. All these cost classifications are meaningful since they can be used to identify the magnitude and relative share of the cost of a program within a society.

In addition to these classifications, there is a special category of program costs. Measured from the viewpoint of the program, these are the costs of operating a program and may include both public costs (governmental expenditures) and private costs (industry donations of time and equipment). Program costs can be used to examine the efficiency of the operation of a program.

Within an educational program, costs can be divided into operating costs and capital costs. Operating costs include personnel costs, transportation costs, maintenance costs, and other costs relating to the current operation of the program. Capital costs include building costs and equipment costs.

At first glance, it might seem that estimates of the costs of vocational education can be accomplished in a straightforward manner. However, a careful study of the nature of vocational education and the availability of the required data reveals that a number of conceptual issues must be discussed before reviewing previous cost-efficiency studies. Measurement problems include the concepts of: (1) expenditures versus costs, (2) size of program, (3) average costs versus marginal costs, (4) the allocation of joint costs, and (5) the imputation of opportunity costs.

Expenditures Versus Costs

It is customary to think of the terms "cost" and "expenditures" as interchangeable. From the economist's point of view, however, these terms are not the same. Costs are related to a specific output. Expenditures, on the other hand, are often stated without relation to the output-time dimension.

Some studies use the budget figure in place of expenditures and costs. Budget figures are not actual but planned expenditures which may be above or below the actual expenditures or costs. In vocational education, some inputs are not consumed during the accounting period in which they were purchased (e.g., buildings, equipment, remodeling expenditures, or books). "Capital costs," as they are called, provide a stream of services over a number of accounting periods before they are exhausted. In such cases it is necessary to employ depreciation allowance estimates in order to convert expenditures to costs.

Finally, a third party (nonschool system) may pay for a teaching or training service or incur expenses on behalf of the vocational education program. These expenditures should be treated as costs of the program. Full and accurate estimation of costs (not merely expenditures) is an essential step in determining the costs of vocational education.

Size of Program

A number of measurements such as the number of students or number of student credit hours can be used to determine the size of a program. Within the student category, there are the average daily enrollment (ADE), average daily attendance (ADA), and number of program graduates (Marson, 1977). Different measurements will provide different meanings. ADA may provide a more accurate measure of the actual size of a program, while the number of successful graduates may underestimate it. On the other hand, ADE may overestimate the size of the program. Cost estimates, especially the concept of average costs and marginal costs, will vary greatly depending upon the nature of the definition.

Average Costs Versus Marginal Costs

Average costs are total costs divided by the program size (students or student credit hours), while marginal costs are the addition to total costs resulting from a small addition (usually one extra student) to the total program. Both types of costs are important information for program management and evaluation. Average costs can provide information on the relative costs per student (credit hour), adjusted by program size. When a program is "efficient," it has the lowest average cost at a given program size. Two types of time dimensions are used to measure minimum average costs--the short-run, which gives the physical capacity of a program, and the long-run, in which the physical capacity of a program can be varied. In fact, all inputs can be varied.

Minimum average costs can provide information on the optimum size of a program, or the most efficient size of a program. Long-run minimum average costs can be viewed in terms of the least-cost combination of all resources. The concept of economies of scale assumes that the long-run average costs can be successively smaller (or increasingly efficient) as the scale of the program (change of physical capacity) increases. On the other hand, decisions on the expansion or contraction of a program are often made on the margin, where the question of additional costs is the major concern. Thus, marginal costs are important in cost studies. Most previous cost studies of vocational education, however, provide only average costs information, while few provide marginal cost estimates (Cohn, Hu, and Kaufman, 1972).

Allocation of Joint Costs

The most common feature of a joint cost is that a specific input or facility may produce two or more distinct program outputs. For instance, an English teacher within a school or a building may teach both vocational and nonvocational students. In practice such joint costs frequently are averaged among different programs.

Aldrich (1972) provided three alternative criteria for allocation of these joint costs--the number of student credit hours, number of full-time equivalent faculty, and classroom square footage. He found that these three criteria provide different cost estimates for vocational education programs. Hu, Lee, and Stromsdorfer (1969) argued that such allocation is always arbitrary in nature and is not necessary. Since the evaluation of a program is more concerned with marginal costs (additional costs of education due to an additional student) than average costs, if the use of the facility by vocational education students does not reduce the ability of other students in the school to use the same facility, then the joint cost to vocational education is zero. Because efficient investment decisions between two alternative programs are made on the basis of marginal costs, joint costs present no basic problem to cost-effectiveness analysis.

The Imputation of Opportunity Costs

Conceptually, costs of vocational education should be defined as total opportunity costs. Economists define opportunity costs as the value of all the real resources used for vocational education that could have been used for other programs. Opportunity costs represent the sacrifice of alternative opportunities to use the

resources. Examples include the donation of equipment by industry to a vocational program or the time the students devote to learning. The equipment from industry could have been used for production while the students' time could have contributed in the labor market. These losses represent potential income loss to industry and students. Thus, these values should be added to the program costs. In the case of industrial equipment, an equivalent rental charge, and in the case of student time, a comparable wage rate for similar types of students (grade, race, sex), can be approximated.

REVIEW OF MAJOR FINDINGS OF COST-EFFICIENCY ANALYSIS

Cost and cost-efficiency studies of vocational education were conducted within two contexts: either for the purpose of measuring the added costs (the difference between vocational and nonvocational programs) of vocational education (Aldrich, 1972; Cohn et al., 1972; Doty et al., 1976; Nystrom and Hennessy, 1975) or for the purpose of cost-benefit or cost-effectiveness comparison of vocational education (Corazzini, 1968; DeVore and Scott, 1974; Harris, 1972 Hu et al., 1969; Kim, 1977; Koch, 1972; Kraft, 1969; McNelly and Kazanas, 1975; Swanson, 1976; Taussig, 1968). Few studies examine the efficiency of vocational education in terms of the marginal and average costs of vocational education and the optimum size of the program (Cohn et al., 1972; Hu et al., 1969; and Osburn and Goishi, 1974). Studies in the late 1960s and early 1970s were conducted on a city basis (Corazzini, 1968; Hu et al., 1969; Kaufman and Lewis, 1968; Taussig, 1968). During the past ten years, many studies were based on state data such as Michigan (Cohn et al., 1972), Puerto Rico (Peat, Marwick, Mitchell & Co., 1971), Florida (Harris, 1972), Illinois (Koch, 1972), Kansas (DeVore and Scott, 1974), Wisconsin (Webb, 1974), Ohio (Ohio State Department of Education, 1975), and New Jersey (Doty et al., 1976).

It is generally known that costs of vocational education are higher than those for nonvocational educational programs, but uncertainty exists over the magnitude of the differences--the so-called added costs of vocational education. Earlier studies only examine the average cost differences between vocational and nonvocational education and the estimates range from $100 to $700 per student or from 1:2 to 2:0 cost ratio per student credit hour. These studies all indicated that teachers' salaries and equipment were the most important factors in the more expensive costs of vocational education. Studies in most statewide vocational cost analyses made detailed estimation of program costs within vocational education. It was found that certain vocational education programs were no more expensive than

nonvocational education programs. Home economics may be cheaper than nonvocational programs, while welding and horticulture may be much more expensive. It was found that the size of the program (number of students) is a major factor in explaining the average cost differences. The larger the size of a program, the smaller the average costs.

Cost estimates from different studies are not exactly comparable. As discussed previously, costs are based on different sources of cost information (expenditures, budget, costs), joint cost allocation methods, cost of living conditions (location), time period, and size of program. Therefore, it would be best to review past studies individually. Since it is impossible to review all past studies on the cost of vocational education, only selected studies will be reviewed.

A study in the Buffalo, New York area (Swanson, 1976) compared the costs and benefits of vocational education. The occupational programs from four school districts were examined based on 1972-1973 data. In this study costs, including the capital costs derived from straight-line depreciation and space costs, were based on rental charges. Both marginal costs and economies of scale were considered in the study. It was found that a wide range of average costs of vocational education existed, from $712 per student for the agriculture program (with 150 students in the program) to $3,935 for horticulture (with only 9 students). The marginal costs per vocational student were $379 for the agriculture program and $3,607 for the horticulture program.

A New Jersey study (Doty et al., 1976) provided a detailed discussion of the problems of cost data collection. The authors found that the average daily enrollment is a better measurement than the average daily attendance when measuring the average costs, since personnel and equipment exist in the program regardless of whether a registered student is attending the school or not. Joint costs estimations were separated at the school district level (administration costs), building level, and vocational program level. Among the twelve schools in the study, the cost for a student in general education was about $4,035 for a two-year period (1973-1975), while the cost for a vocational student for the same two-year period was $4,799.

A study analyzing the operating costs of secondary level vocational education in Ohio (Ohio State Department of Education, 1975), during the 1973-1974 academic year found that average costs per vocational program class (with twenty-two students) were $26,344 or about $1,197 per student. In terms of cost per student hour, it was $1.56 for vocational students and $1.24 for nonvocational students. The cost allocation procedure in this study is very similar to that of the New Jersey study.

An Illinois study (Nystrom and Hennessy, 1975) examined twenty regular secondary schools and five vocational secondary schools. The study compared the cost per credit hour ratio between vocational and nonvocational programs. It was found that vocational education was about twice as expensive as nonvocational programs. Similarly, a Missouri study (McNelly and Kazanas, 1975) examined twelve schools and included foregone earnings of in-school versus co-op students in vocational education. The authors found that the average cost was about $460 for co-op students and $626 for in-school vocational education students.

A Kansas study (DeVore and Scott, 1974) was based on fourteen vocational schools in 1970. The study relied on aggregate data from school district budgets and the number of completed vocational education graduates. Cost estimates from this approach, as discussed earlier, are not reliable.

Based on the Missouri data, a study by Osburn and Goishi (1974) examined the factors influencing costs among area vocational schools. The study dealt with the economies of scale by estimating average cost function. The size of the program was defined as full-time equivalent students. The estimated optimum size of the vocational school was about 400 to 500 students. Obviously, these figures are reflected by fifteen sample schools included in the study, which may not be applicable to other states. A total cost function was also estimated to measure the marginal costs of additional vocational students, about $145 during the 1968-1969 period.

A cost analysis of secondary vocational education in six Tennessee schools was completed by Harris (1972). Ranges of cost estimates by course, program, and cost category based on enrollments and capacity of enrollments were obtained. Total costs per pupil contact hour ranged from less than $1 to over $2. A statewide survey of Michigan secondary schools (Cohn et al., 1972) revealed that the average costs per student hour for vocational education and nonvocational education programs were $278 and $187 respectively. Thus, the added cost ranges from a low of $15 for home economics to $365 for welding programs. Marginal costs of vocational and nonvocational programs were also estimated. These costs ranged from $157 to $187 per student hour for nonvocational programs. For vocational programs, the range was from $24 to $648.

Another study of the costs of secondary vocational education based on Baltimore, Detroit, and Philadelphia data (Hu et al., 1969) covered the period of 1956 through 1960. Total educational costs were computed on the basis of estimates of both current and capital costs. Added costs of vocational education were obtained by subtracting average costs for secondary comprehensive schools from their vocational school counterparts. The estimated average

costs for vocational education were $156 in Detroit and $116 in Philadelphia.

Corazzin (1968) conducted an earlier study of the costs (and benefits) of secondary education in Worcester, Massachusetts. He compared per pupil costs for vocational programs with costs for pupils in basic high school programs in 1963-1964. A substantial difference was found in per pupil cost between basic high school programs and vocational programs. Specifically, costs for students in basic programs averaged $452 compared to $964 for traditionally "male" vocational school programs and $793 for traditionally "female" vocational school programs. The differences in costs were attributed principally to differences in teachers' salaries per pupil in basic and vocational education programs. Corazzini reestimated costs by including adjustments for "public implicit costs," that is, capital costs and property tax costs. The addition of public implicit costs raised the cost estimates by $80 per pupil for basic high school education, and $246 per pupil for the "male" vocational school programs, increasing further the difference between vocational and basic high school costs.

A similar study was conducted for the New York City vocational and academic high school programs (Taussig, 1968) for the 1964-1965 period. Taussig estimated the combined current and capital annual costs per pupil and, from these data, the average added costs of vocational education. His analysis indicated that per student costs were $1,188 for academic schools and $1,697 for vocational schools, a difference of $509. Although Taussig included capital costs, the estimation of capital costs was based on simple approximation of current costs.

Several other studies have estimated the costs of vocational education at the secondary, postsecondary, and junior college levels. The estimated average vocational costs for high schools range from about $430 to $615 per year based on current costs information, and $520 to $740 based on total resources, which include opportunity costs and capital costs (Eninger, 1967; Fernback and Somers, 1970; Kaufman and Lewis, 1968). Estimated average vocational costs for postsecondary and junior colleges range from $2,500 to $2,840 per year based on current costs information, and $3,084 to $3,874 per year based on total resources costs (Carroll and Ihnen, 1967; Fernback and Somers, 1970; Webb, 1974). The cost of either vocational or nonvocational education is higher at the postsecondary level than at the secondary level. The higher amount is due to much higher faculty salaries and foregone earnings of postsecondary students. The cost differences are $300 to $800, depending upon the student time period, the components of cost estimates, and the location of the schools.

Previous studies indicate that most efforts were devoted to estimating the average costs of vocational and nonvocational education and few studies were concerned with marginal costs and optimum size (the concept of least costs) of programs. To improve cost-efficiency estimation, two efforts must be promoted. First, proper data collection and systematic procedures of cost classification should be implemented. Recent studies (Kim, 1977; Marson, 1977) have provided facilities for schools and educational agencies to achieve such objectives. Second, the estimation of marginal costs and optimum size requires economic and statistical training. A regression analysis is often required to perform such estimates. Researchers in the field may wish to consult previous reviews of vocational education (Stromsdorfer, 1972) and some basic econometrics texts on cost function estimation (Hu, 1972; Johnston, 1960).

CONCEPTUAL FRAMEWORK AND PROBLEMS IN CONDUCTING COST-EFFECTIVENESS (BENEFIT) ANALYSIS

The effectiveness of a vocational program includes both economic and noneconomic benefits which can be attributed to vocational training. A benefit can be defined as any result of the vocational education process that increases individual or social welfare. This increase in welfare can be either economic or noneconomic. With respect to economic welfare, benefits occur either directly, by increasing productivity, or indirectly, by freeing resources for alternative uses. Increasing productivity, as a result of education, implies more output per unit of input than before. The increase of productivity may in turn increase the wage rate of vocational graduates. In this sense, vocational education can be considered an investment program.

With respect to noneconomic welfare, the educational process may result in an increased level of satisfaction for those participating in the educational process. The possible reduction of undesirable social behaviors or crimes as a result of education, the improvement of citizenship, and greater job satisfaction are also considered noneconomic benefits. Job satisfaction is more particular to vocational education, while the other benefits are applicable to all types of educational programs, although they may vary in degree. These values may not be quantifiable in monetary terms. To ignore these noneconomic benefits, however, and concentrate on economic benefits, is to underestimate the total benefit of vocational education.

There are measurement problems for both economic and noneconomic benefits. These measurement problems include (1) the concept of wages versus earnings, (2) noneconomic benefits, (3) transfer payments, (4) the identification of net effectiveness (or

benefits) due to vocational education, and (5) timing and discounting.

Wages Versus Earnings

Wages per hour or per week are used to measure the productivity of a worker and reflect both the demand and supply of a given type of labor skill. Earnings are the product of wages and the time period of employment and may also include incomes earned from another type of job. One may have a relatively high wage and work only a short period of time, or one may have a relatively low wage and work during the entire year. Therefore, these two measurements have two different implications. To evaluate the productivity of vocational graduates, the wage rate should be used. To evaluate the earning ability, including the ability to be employed, earnings should be used. Most studies have used earnings as measurements of the economic benefits of vocational education (Corazzini, 1968; Taussig, 1968). Other studies have used wages, earnings, and employment period, so that separate effects can be examined (Hu et al., 1969; Swanson, 1976).

Noneconomic Benefits

Economic benefits are only one element of well-being. One of the elements of satisfaction gained besides earnings is direct consumption benefits during the educational process itself, as well as increased potential for consumption after education. Most people will gravitate to education and occupations which will give them direct consumption benefits along with increased earnings. This is the crux of the matter when educators, economists, and others seek to measure the degree of "job satisfaction" involved in career choice.

Job satisfaction is a measure of psychological well being. If different kinds of persons gravitate to different programs, it is difficult to establish unambiguous scales to measure these direct consumption and psychological benefits. Different elements may compromise the consumption and receipt of psychological benefits by different groups. Thus, even if the same kinds of questions are asked of different groups, seemingly uniform and consistent responses may have entirely different meanings (Stromsdorfer, 1972). Researchers have continued to improve the instruments used to measure job satisfaction and have been increasingly careful in interpreting the findings (Eninger, 1972; Swanson, 1976).

In addition to the measurement of job satisfaction, the possible reduction of the school dropout rate, reduction of crime, and improvement of citizenship also belong to noneconomic benefits. Vocational education appears to have holding power for school dropouts (Karnes, 1966). Some property crimes can be evaluated by their dollar value, while others are difficult to estimate in terms of dollar value. Citizenship can be measured in terms of political participation such as voting (Hu et al. 1969), volunteering for community work, and nonavoidance of military or other national service. Again, citizenship is difficult to evaluate in dollar terms, but it is easier to measure in nonmonetary terms. Therefore, these measures should be considered as indices. The relative magnitude of these indices can be compared among vocational graduates and nonvocational graduates.

Transfer Payment

Transfer payments are defined as payments made from one party to another without receiving services or contributions of productivity in return. The simplest example is the weekly allowance given by parents to their children. In the public sector, welfare payments paid by the government to low income families are considered transfer payments. One can argue that vocational education may increase a graduate's employment and earning power and as a result, government may pay less welfare allowance than otherwise (Davie, 1967). This reduction of welfare payments may be a benefit to government itself, but may neither reduce nor increase social benefits. From the point of view of society, the total payments remain unchanged. If we do not compare the interpersonal utility of money, the comparison of social benefits to transfer payments is not necessary. The comparison is difficult to measure because measurements are rather subjective. Transfer payments are relevant only when they are used to measure the impact of vocational education on the benefits of government programs.

Identification of Net Effectiveness (or Benefits)

Regardless of whether effectiveness is considered in economic or noneconomic terms, the problem lies in identifying indicators which are indeed due to the contribution of vocational education. There are two potential sources of difficulty in obtaining reliable effectiveness (benefit) estimates. One is the proper control group (or comparison group); the other is the self-selection bias among participants (Stromsdorfer, 1972). The ideal approach is to compare the experimental group with a control group. Ideally, the control should be a matched group drawn from the

same population as the experimental group. Properly matched control groups are not easily obtained, however, especially when educational program choices are determined by students or their parents.

Even if a properly matched control group is obtained, observed differences may be due not to participation in the program, but to a self-selection bias toward the objectives of vocational education, such as a stronger motivation toward job market participation. In such cases, statistical tests of the individual characteristics of the experimental and control groups should be performed before intergroup comparisons are made (Hu et al., 1969). Heckman (1976) has developed procedures to adjust for self-selection bias.

Most studies comparing vocational and nonvocational programs are quasi-experimental in nature. The pre- and postcomparison on their respective labor market or noneconomic indicators cannot be simply attributed to vocational education training. Other confounding variables such as students' IQ, family background, and socio-demographic factors also may affect outcomes. Therefore, multivariate analyses, such as regression techniques, should be used to control those differences so that the net effect of vocational education can be identified.

Timing and Discounting

An educational program may take different lengths of time to have an impact in terms of different effectiveness indicators (dropout rate, job seeking period, employment period, wage rate, earnings, job satisfaction, and social behavior). Furthermore, the durability of these indicators may also vary over time. Therefore, the timing of evaluation is an important consideration. The evaluation could be conducted too soon to produce meaningful or accurate results. Furthermore, a program should not be assumed to last forever. A program evaluation occurring at unreasonable time periods may generate unreasonable conclusions.

In addition, effects of training may be realized years later. In order to have a comparable basis, the streams of costs and benefits should be converted into present value. The choice of proper discount rates may also affect the results of the cost-effectiveness or cost-benefit analysis. The discount rate varies over time depending upon the condition of the monetary market. In the 1960s, most studies used 5 percent or 8 percent as a discount rate. In recent years, however, most studies used 8 to 10 percent as a discount rate. The higher the discount rate, the smaller the value of present benefits.

In summary, the task of measuring effectiveness is at least as difficult, if not more so, than the task of measuring costs. The next section provides a brief review of previous studies on the effectiveness of vocational education and the comparison of costs to effectiveness.

REVIEW OF MAJOR FINDINGS OF COST-EFFECTIVENESS (BENEFIT) ANALYSIS

Most previous studies of the effectiveness of vocational education emphasized economic benefits and basically excluded noneconomic benefits (Stromsdorfer, 1972). As is the case with cost analysis, most studies of cost-effectiveness (benefits) are based on school district, city, state, or regional area. There are a few national studies of the effectiveness of vocational education (Eninger, 1972; Fernback and Somers, 1970; Lee, 1976). Although earlier studies (Corazzini, 1968; Taussig, 1968) questioned the economic returns of vocational education, studies during the 1970s generally had more favorable findings than earlier studies (Warmbrod, 1977). Again, not all programs within vocational education, especially high cost programs, are rewarded with economic returns (Swanson, 1976).

Noneconomic benefits of vocational education have been increasingly emphasized (Eninger, 1972; Hu et al., 1969; Kaufman and Lewis, 1968; Lee, 1976; Sparks, 1977; Swanson, 1976). Economic gains for graduates is only one of several objectives on the part of vocational education. The problem of weighing and measuring these multiple objectives has been a task for many evaluation researchers in vocational education (Moss and Stromsdorfer, 1971; Sparks, 1977). For illustrative purposes, some major studies of the economic and noneconomic aspects of cost-effectiveness of vocational education are reviewed here.

Two studies (Marson, 1977; Webb, 1974) were conducted in Wisconsin during the past five years. The Marson study involved a one year (1976-1977) cost-benefit analysis of nine vocational education programs and sixty-three adult education courses from three vocational schools. The Webb study examined one school district's vocational-technical school, based on 1971, 1972, and 1973 classes. Both studies provided a detailed format for calculating costs and benefits of vocational education, including student opportunity costs and noneconomic benefits of vocational education. The authors concluded that vocational education is a worthwhile investment, based on the benefit-cost ratio and other investment criteria. Although the noneconomic benefits, such as the percent of job satisfaction among vocational graduates and nonvocational graduates (83 percent versus 82 percent), were

estimated, one really cannot, without a statistical test, claim that vocational programs are better than nonvocational programs.

The Buffalo, New York study (Swanson, 1976) was based on eight-year longitudinal information from four school districts. Sixteen occupational programs were examined. A total of 628 vocational graduates and 422 nonvocational graduates from the classes of 1969, 1971, and 1973 were compared. Both earnings and wages of these graduates were compared during the 1973 period. Swanson examined the issue of nonresponse bias and derived a seven-year period of benefit streams to compare students' training costs. It was found that male vocational graduates have higher earnings than male nonvocational graduates. Their wage rates, however, were comparable two years after graduation. On the other hand, the female vocational graduates gained less than nonvocational female graduates after the fourth year of graduation. It was also found that 73 percent of the vocational graduates were willing to take the program again if offered, while 60 percent of the nonvocational graduates were willing to retake the program. Job seeking time was more favorable for vocational graduates than nonvocational graduates. Again, not all vocational programs paid off the training, depending upon the nature of the program and the demand condition of the job market.

Project Baseline (Lee, 1976) is a nationwide survey of vocational education graduates that was initiated in 1971. As Lee admitted, response bias and unknown factors in nonresponse bias are possible in the survey data. Lee's early 1976 survey indicated there was 15 percent unemployment among vocational graduates employed in 1975, while the total labor force unemployment rate at the time was 19.9 percent. Furthermore, the unemployment rate for vocational program graduates in 1976 was 11.5 percent, which was 5.5 percent lower than the national average for the comparable age group (16-24 years old). It should be noted that no cost-effectiveness or cost-benefit analysis was estimated in this study.

Two Ohio studies (Ghazalah, 1972 and 1975) reviewed vocational education both in terms of economic return and noneconomic benefits. In his 1975 study, Ghazalah estimated the present net social value of a vocational program versus the present net social value of an academic program. He stated that increasing the participation rate of senior high school students in vocational programs to 40 percent of the average daily attendance in all 103 vocational planning districts in Ohio would result in a statewide increase in net social benefits from $109 million to $327 million. He found that the size of benefits depended upon the alternative to vocational education (taking the academic program or dropping out), characteristics of program enrollees (male or female), and the size of the program. Ghazalah's 1972 study examined the private and social costs and returns to

vocational programs offered at the high school level in Ohio. His findings indicated a favorable return to the vocational investment and suggested the expansion of vocational education. He examined the job satisfaction level, self-confidence, work attitude, communication skills, and interpersonal relationships among vocational and nonvocational graduates.

In Missouri, twelve vocational schools were studied for the cost-benefit of cooperative vocational and in-school vocational programs (McNelly and Kazanas, 1975). A total of 219 students was included in the study. McNelly and Kazanas found that cooperative vocational education has a higher benefit-cost ratio (9:1 to 10:1) than in-school vocational education (2:1 to 7:1), discounted by either 8 or 10 percent of the discount rate. The in-school benefit-cost ratio can be calculated either by including the program earnings or otherwise. Benefits of both programs, however, are higher than their respective costs.

A Kansas study by DeVore and Scott (1974), based on the the 1970 census, examined earnings of fourteen Kansas vocational school graduates. In a comparison of these earnings to the costs of training (again derived from census data), it was estimated that per student return would be $269 in wages earned above and beyond the high school graduates. In other words, the study showed that it requires 2.41 years to pay back the costs of the vocational investment. A similar approach was taken on the cost-benefit analysis of five Illinois junior college vocational programs (Koch, 1972) based on census reports. Only the internal rate of return was calculated for these programs--12.3 percent for the private rate of return and 8.9 percent for the social rate of return. Koch used the U.S. Treasury bill rate (3.7 percent) and U.S. Treasury note rate (6.2 percent) as the comparison benchmark. Obviously, the investment in vocational education had a higher return than investment in the money market during that time period.

Project Metro (Eninger, 1972) was a national study obtained from 34,710 high school graduates in 1970 from major cities of more than 250,000 population. It emphasized economic and noneconomic benefits of vocational education. Among vocational graduates, about 43 percent were employed full time, while 34 percent of academic graduates were employed full time. Vocational graduates were able to get a job in a shorter time period than nonvocational graduates. Although hourly earnings of vocational graduates are slightly higher than those of nonvocational graduates, the difference is small, about five to fifteen cents difference. Project Metro also examined students' view of their education. Of those employed in a training-related field, there was almost a record 95 percent endorsement. There was no response from unemployed graduates, however. This study does not provide a

cost-effectiveness analysis of vocational programs. Like Project Baseline, it focuses on the outcome of vocational education programs.

A national study (Fernback and Somers, 1970) indicated that vocational graduates earned an average of $667 more per year than did secondary academic graduates. The total social costs of vocational education amounted to an average of about $270 per year. Therefore, the average rate of return to vocational education was about 21.4 percent. If the rate of discount was 10 percent, the net present value of benefits for vocational education was $2,484 per vocational graduate.

A study by Hu et al. (1969) indicated that vocational graduates earned an average of $343 and $643 more per year than did comprehensive graduates in two cities. Considering the total costs of vocational education, the average rate of return to vocational education was approximately 8.2 percent for Philadelphia, and 31.8 percent for Detroit. When the benefits and costs were discounted at 10 percent, the net present values of benefits were zero and $1,102 for the two cities respectively. The authors investigated citizenship in terms of political voting participation and relevance of job to educational program among vocational and comprehensive graduates. The study found that vocational education is generally more immediately relevant to the vocational graduate's job than education is to the job of the academic graduate. There was, however, no significant difference between vocational and academic graduates in terms of voting participation. Kaufman and Lewis (1968) also studied job satisfaction of vocational and nonvocational graduates. They found there were large returns to vocational education, at least a 25 to 30 percent rate of return, and net benefits ranging from $1,500 to $4,200, depending upon the magnitude of the discount rate.

One of the earlier studies (Corazzini, 1968) examined samples of male students from the 1963 to 1964 period in Worchester, Massachusetts. The author found that vocational graduates earned $312 more per year than comprehensive graduates. Considering cost of training differences, vocational education received about a 17.9 percent rate of return or a $412 net present value.

During the same period, a study (Taussig, 1968) based on New York City vocational graduate data found that vocational education had a rate of return of only 5 to 7 percent, with almost negative present value of benefits. The variations of these empirical estimates are due to different methods of computing costs and benefits and different study samples.

A study (Eninger, 1967) based on the 1953-1965 Project Talent data found that vocational graduates earned $375 more per year

than their college preparatory counterparts. Given the total resource costs per vocational student, about $570 per year, the rate of return to vocational education was 13.8 percent, and the net benefits (discounted at the 10 percent rate) were $307 per student.

With a similar approach to benefit-cost estimation, Fernback and Somers (1970) found that a postsecondary vocational graduate earned about $996 per year more than secondary academic graduates. The average total costs per postsecondary vocational graduate were $3,000 per year. The calculated rate of return to postsecondary vocational education was 6.8 percent, and the negative net benefit was calculated using a 10 percent rate of discount. On the other hand, an earlier study (Carroll and Ihnen, 1967) found a 16.5 percent rate of return to postsecondary vocational graduates, and $5,157 net present benefits.

Previous studies indicate that the effects of vocational education programs on job search time period, employment, and earnings are favorable. The noneconomic benefits of vocational education have also been increasingly recognized by researchers. The investment criteria such as benefit-cost rate, net present value of benefits, rate of return, and payback period were all familiar to program evaluators. The issue of the identification of net effect of vocational education on economic and noneconomic benefits still needs to be explored and recognized. With the quasi-experimental data, a simple comparison between vocational graduates and nonvocational graduates does not provide clear-cut evidence of net effects of vocational education. Many previous studies lack rigorous statistical techniques to control for the confounding factors (i.e., race, sex, location) among vocational and nonvocational graduates. Without these techniques, a simple comparison of economic and noneconomic benefits between vocational and nonvocational graduates may be misleading.

CONCLUDING REMARKS

It is apparent that many studies have been carried out on cost-efficiency and cost-effectiveness (benefit) analyses of vocational education during the past decade. The general conclusions of past studies indicate that vocational education is more costly than nonvocational education, ranging from $200 to $700 per student or a ratio of 1:5 to 2:0, depending upon the type of the program, the size of the program, and the location of the program.

Several studies have provided detailed cost categories for vocational education, including the allocation of joint cost and procedures for depreciation. Empirical estimation of marginal

costs of vocational education and the optimum scale of vocational education programs is still rare, however. For planning and evaluation purposes, these research areas should be expanded in the future. It is possible that programs may not be cost-effective due to the relatively "high" cost of the operation. If a program is implemented efficiently, program costs may be reduced and the program may become cost-effective.

In terms of the previous results of cost-effectiveness and cost-benefit analysis of vocational education, most recent studies have found that the effects of vocational education on labor market performance are more favorable than the effects of non-vocational education. This, again, depends on the type, cost, and location of the program. Recent studies show increasing awareness of the economic as well as noneconomic benefits of vocational education and have attempted to measure these outcomes. Researchers also have become familiar with different investment criteria and consider the cost-effectiveness approach a feasible technique in evaluating vocational education. The issue of identifying the net contribution due to vocational education is still not resolved, however, due to either the lack of proper data collection or the required statistical technique.

If policy makers in vocational education wish to pursue a more rational course with respect to investment in vocational education, adequate cost data must be collected based on sound cost accounting principles. Meaningful effectiveness data must be collected and guided by agreed-upon objectives and definitions of output to measure these objectives, and proper statistical techniques must be adopted for the analysis of data. Future studies of vocational education should be focused not only on the economic data but also on the noneconomic benefits and costs of vocational education. In this respect, economists, educators, and psychologists should work together to improve the techniques of cost-effectiveness analysis of vocational education.

One of the ultimate objectives of research into this area, like many other social programs, is to inform the policy makers, educators, and the public about the effects of vocational education so that resources can be allocated in an economical way. Therefore, it is important for researchers to disseminate their findings. It is equally important to involve education policy makers with researchers in the conduct of cost-effectiveness analysis of vocational education, so that the results of research can have a direct bearing on the decision-making and implementation processes.

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